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10/585,744	07/12/2006	Akira Bandoh	Q81505	1506

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EXAMINER
AHMED, SELIM U

ART UNIT	PAPER NUMBER
2826	

NOTIFICATION DATE	DELIVERY MODE
11/30/2009	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/585,744	BANDOH ET AL.	
	Examiner	Art Unit	
	SELIM AHMED	2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *07 August 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *37-68* is/are pending in the application.

4a) Of the above claim(s) *38-54, 67, 68* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *37 and 55-66* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *12 July 2006* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

1. Applicant's response filed on 08/07/2009 is acknowledged. Applicants have amended claims 37, 55. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 37, 55-60, 63, 64 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Kawano (JP 2003-17420; Machine translation was used for examination purposes) in view of Guo et al (US 2004/0119063; Guo hereinafter).

With regard to claim 37 or 55, Kawano discloses an n-type group III nitride (e.g. GaN) semiconductor layered structure (Fig. 1) or a process (e.g. VPE) for producing a n-type group III nitride (e.g. GaN) semiconductor layered structure (e.g. Fig. 1) comprising a substrate 1 and, stacked on the substrate (e.g. Fig.1), an n-type impurity concentration (i.e. Ge, para[0026]) periodic variation layer (e.g. para[0042]) comprising an n-type impurity atom higher concentration layer 3 (para[0018], claims 1-4) and an n-type impurity atom lower concentration layer 4 (para[0018] claims 1-4), said n-type impurity atom being Ge (e.g. para[0042]),

pits (e.g. para[0010, 0035]) being provided on a surface (Fig. 1) of the higher concentration layer 3 (a surface remote from the substrate), and said lower concentration layer 4 being stacked on said higher concentration layer (e.g. para[0042]), wherein the higher concentration layer and the lower concentration layer are provided in an alternate and periodic manner (e.g. para[0012, 0039-0042], claims 6-8).

Furthermore, with regard to claim 55, para[0009] of Kawano discloses a process (e.g. VPE) for producing a n-type group III nitride (e.g. GaN) semiconductor layered structure, wherein each of said n-type impurity atom (para[0026]) higher concentration layer 3 and said n-type impurity atom lower concentration layer 4 is stacked so that, in addition to the concentration of the n-type impurity to be doped, conditions for growth within a reactor are also differentiated (e.g first process, second process, para[0009]).

With regard to claims 37 and 55, Kawano discloses all the claimed subject matter except for the repetition number of said higher concentration layer and said lower concentration layer is 10 to 1000 and a thickness of a repetition cycle is 1 nm to 1000 nm. In para[0012, 0039-0042] and claims 6-8 of Kawano discloses more than one repetition of said higher concentration layer and said lower concentration layer rather. In para[0027] of Kawano discloses a thickness of a repetition cycle is as low as 10 um. However, in Fig.1, para[0134] of Guo

discloses Aluminum nitride and Gallium nitride superlattice repetition layers 20, 22 with 5-15 repetitions of layers 20, 22 with a thickness on the order of 10 nm or less. According to para[0013] of Guo discloses, "…superlattices introduce compressive strain into the gallium nitride-based semiconductor materials in the structure and, hence, prevent cracking of the gallium nitride based semiconductor layers. Further, it is also believed that the superlattices serve as "filters" which limit propagation of crystalline defects such as those referred to as threading dislocation from the lower layers of the structure upwardly into the operative structure at the top. These factors are believed to contribute to the high crystal quality of the gallium nitride-based semiconductors in the operative structure. Further, it is believed that the superlattices tend to limit diffusion of silicon into the gallium nitride-based semiconductors." So, it reasonable to assume that one would optimize the repetition number and thickness of the superlattice layer i.e. applicant's high and low concentration GaN layers for desirable output. It would have been obvious to one of ordinary skill in the art to form the repetition number of 10 to 1000 of said higher concentration layer and said lower concentration layer and a thickness of a repetition cycle is 1 nm to 1000 nm through routine experimentation of the film deposition chemistry and parameters. It is well known in the semiconductor fabrication process to optimize the thickness of a parameter within a technology using design of experiment (DOE) technique to meet certain product specific performance and reliability. Moreover, there is no evidence indicating the ranges of the repetition number

and thickness are critical and it has been held that it is not inventive to discover the optimum or workable range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP 2144.05. Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is said to be based upon particular chosen dimensions or upon another variable recited in a claim, the Applicants must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

With regard to claim 56, e.g. para[0010] of Kawano discloses the process according to claim 55 wherein conditions for growth of the lower concentration layer 4 are differentiated from conditions for growth of the higher concentration layer 3 so that two-dimensional growth of the layer is accelerated during the growth of the lower concentration layer.

With regard to claim 57, e.g. para[0025, 0033] of Kawano discloses the process according to claim 55, wherein the lower concentration layer is grown at a temperature different from the temperature at which the higher concentration layer is grown (800C and 900C).

With regard to claim 58, e.g. para[0025, 0033] of Kawano discloses the process according to claim 57, wherein the lower concentration layer 4 is grown at a temperature (e.g. 900C) above the temperature (e.g. 800C) at which the higher concentration layer 3 is grown.

With regard to claim 59, e.g. para[0039, 0040] of Kawano discloses the process according to claim 55, wherein the lower concentration layer 4 is grown at a pressure different from the pressure at which the higher concentration layer 3 is grown.

With regard to claim 60, e.g. para[0039, 0040] of Kawano discloses the process according to claim 59, wherein the lower concentration layer 4 is grown at a pressure (e.g. 1E10-8 atm) lower than the pressure (e.g. 2.87E-7 atm) at which the higher concentration layer 3 is grown.

With regard to claim 63, e.g. para[0080] of Kawano discloses the process wherein the growth speed of the lower concentration layer is different from the growth speed of the higher concentration layer (100 um/hr and 50 um/hr).

With regard to claim 64, Kawano does not specifically disclose the process wherein the growth speed of the lower concentration layer is lower than the growth speed of the higher concentration layer. In para[0039, 0040] of

Kawano discloses growth rate of lower and higher concentrations layers as 50 um/hr while in para[0080] growth speed of the lower concentration layer and higher concentration layer are disclosed 100 um/hr and 50 respectively. So, it is reasonable to say that growth speed can be varied as desired with specific requirements of the process. Furthermore, it is well known and common knowledge in the art that the growth speed can be controlled with process parameters such as, temperature, pressure, gas flow etc. For example, US 0213964, para[0290] discloses, “higher growth rate >5 microns per hour) have a comparable affect on the morphology smoothing as do lower growth rate. Higher growth rates enable smoothing of the wafer surface more quickly than lower growth rate enabling improved process throughput and reduced process costs." It would have been obvious to one of ordinary skill in the art at the time the invention was made to optimize the growth speed such that the growth speed of the lower concentration layer is lower than the growth speed of the higher concentration layer and results would have been predictable.

3. Claims 61, 62 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Kawano in view of Guo and further in view of Seki et al (US 5129986; Seki hereinafter).

With regard to claim 61 and 62, Kawano in view of Guo discloses all of the limitations of claim 1 but does not specifically disclose the process wherein the

carrier gas flow rate in the growth of the lower concentration layer is different from the carrier gas flow rate in the growth of the higher concentration layer or wherein the carrier gas flow rate in the growth of the lower concentration layer is higher than the carrier gas flow rate in the growth of the higher concentration layer although in para[0037] Kawano discloses hydrogen was used as carrier gas at the time of the growth. Furthermore, col.3, lines 40-47 of US 5129986 discloses that higher inert (i.e. carrier) gas flow rate reduces the dopant concentration due to the evaporation of the dopant. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the (different) flow rate of carrier gas such as claimed and results would have been predictable i.e. high and low doping concentration layers.

4. Claims 65, 66 are rejected under 35 U.S.C. 103 (a) as being unpatentable over Kawano in view of Guo and further in view of Anayama et al (US 5,862,166; Anayama hereinafter).

With regard to claim 65 and 66, Kawano in view of Guo discloses all of the limitations of claim 1 but does not specifically disclose the process wherein the nitrogen/III ratio in the growth of the lower concentration layer is different from the nitrogen/III ratio in the growth of the higher concentration layer and wherein the nitrogen/III ratio in the growth of the lower concentration layer is lower than the nitrogen/III ratio in the growth of the n-type impurity atom higher concentration

layer. However, it is well known and common knowledge in the art to optimize the gas ratio of specific processes to meet desired process specific parameters. Furthermore, col.8, lines 40-60 of Anayama discloses the nitrogen/III ratio in the growth of the lower concentration layer is different from the nitrogen/III ratio in the growth of the higher concentration layer and wherein the nitrogen/III ratio in the growth of the lower concentration layer is lower than the nitrogen/III ratio in the growth of the n-type impurity atom higher concentration layer. In col.7, lines 45-50 of Anayama discloses that V/III ratio has effect on pit density. It would have been obvious to one of ordinary skill in the art at the time the invention was made to have the specified nitrogen/III ratio and results would have been predictable.

Response to Arguments

5. Applicant's arguments with respect to claims 37, 55-66 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

6. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory

action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SELIM AHMED whose telephone number is (571)270-5025. The examiner can normally be reached on 9:00 AM-6:00 PM. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Sue Purvis can be reached on (571) 272-1236. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-

free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/SA/

/Sue A. Purvis/
Supervisory Patent Examiner, Art Unit 2826